T247

MODEL T247

CALIBRATION CHECKER

SERVICE MANUAL

wilcom

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CALIBRATION CHECKER

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WILCOM'S obligation under this warranty is limited to servicing or adjusting each instrument returned to its factory within the warranty period, and to replace any components which are found to be defective. If in WILCOM'S judgement the defective condition is a result of misuse or abnormal operation, repairs will be billed.

If faulty conditions develop, notify WILCOM for instructions. Servicing information will be supplied wherever possible. If the equipment is to be returned for repairs, please include a description of the faulty condition and who should be contacted if additional information is needed. Ship the equipment prepaid.

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1.0 GENERAL

1.1 Description

1.1.01 The Model T247 Calibration Checker is a compact, lightweight test set designed for field calibration and function checking of the various models of the Wilcom T136 Circuit Test Set. Individual switch selected outputs are provided for checking proper function of the T136 under test in DIAL, LOOP mA, CKT LOSS, CKT NOISE, and PWR INFL. The internal switching of the T247 provides the required interconnection of the T136 input leads for each function. The T247 may be powered by either 115V ac or -48V office battery.

1.1.02 In the CKT LOSS, CKT NOISE, and PWR INFL functions, the T247 sends five tones, switch selectable, between 325 Hz and 4000 Hz. The 1000 Hz CKT LOSS and CKT NOISE outputs are at precise levels suitable for level calibration of the CKT LOSS and CKT NOISE circuits in the T136. The other outputs are less precise, but are sufficiently accurate to permit verification of the proper function of the T136. In CKT LOSS, the output level is the same for all five frequencies to permit checking the flat response of the T136. In CKT NOISE and PWR INFL, the output levels are set to the inverse of C-message weighting, so that a properly functioning T136 will indicate reference level (30 dBrnc CKT NOISE or 90 dBrnc PWR INFL), within allowable tolerance, for any selected frequency.

1.1.03 The T247 also includes a 3-position, 10 dB per step, LEVEL switch which permits setting the output level 10 dB above or below the normal reference level. This switch is used with certain T136 models which have a different reference level, and also for checking the range extender push-buttons on the T136. A HUM REJECT TEST pushbutton adds a 180 Hz interference tone in the CKT LOSS function to verify the low frequency reject characteristic of the T136 CKT LOSS circuit. In DIAL function, a light emitting diode on the T247 panel verifies continuity between T and R leads and the DIAL posts on the T136. In CKT LOSS, CKT NOISE, and PWR INFL, another LED indicates dc continuity through the T136 hold coil. In the LOOP mA function, the T247 delivers a 23 mA dc current for checking the LOOP mA function in the T136. A FROGGING switch reverses the connection to T and R leads of the T136. This is needed to check proper polarity for dc LOOP mA measurement in those T136's not equipped with a polarity bridge. Also, in CKT LOSS and CKT NOISE, the T247 test tone is unbalanced; an unbalancing fault in the T136 will show up as an error in one position or the other of the T247 FROGGING switch.

2.0 SPECIFICATIONS:

2.1 dc OUTPUTS

2.1.01 DIAL function: Continuity check

2.1.02 LOOP mA function: 23 mA ±3% into a 200 ohm load.

2.2 ac OUTPUTS

2.2.01 FREQUENCY: 325 Hz, 500 Hz, 1000 Hz, 3000 Hz, 4000 Hz, all ±1%, switch selectable.

2.2.02 OUTPUT IMPEDANCE:

CKT LOSS & CKT NOISE: 600 ohm, unbalanced, to terminals marked GRN and RED.

PWR INFL: Low impedance; terminals marked GRN and RED are both connected to high side of output, terminal marked YEL to low side.

2.2.03 OUTPUT LEVEL:

CKT LOSS: (calibrated for measuring set with 735 ohm input impedance.)

at 1000 Hz: 0 dBm ±0.05 dB
at other frequencies: 0 dBm ±0.1 dB

CKT NOISE: (calibrated for measuring set with 735 ohm input impedance.)

at 1000 Hz: 30.0 dBrnc ±.1 dB
at other frequencies: 30 dBrnc ±.3 dB
(Voltage output varies with inverse of C-Message weighting for flat dBrnc output.)

PWR INFL: (Voltage output; at 1000 Hz, 0 dBrnc is defined as 24.5 uV.)

at 1000 Hz: 90 dBrnc ±.2 dB
at other frequencies: 90 dBrnc ±.5 dB
(Voltage varies with inverse of C-Message weighting.)

2.3 LEVEL switch: 10 dB ±.1 dB each step.

2.4 HUM REJECT TEST pushbutton: 180 Hz ±5%, at -1.5 dBm ±1 dB level, added to output in CKT LOSS function. (T136 circuit should reject this frequency sufficiently that level reading on other tones increases approximately .5 dB, where without the reject it would increase 2 dB.)

2.5 POWER: 115V, 50/60 Hz or -44V to -52V office battery.

2.6 ENVIRONMENTAL: Operating Temperature: 0 to 50° C;
for full specified accuracy: +15° C to +40° C.

Humidity: 95% at 35° C.
40% at 50° C.

Storage Temperature: -55° C to +70° C.

Altitude (non-operating): 50,000 Ft.

2.7 SIZE: Portable case, 11" wide x 8" high x 8 1/2" deep, including cover, handle, wall mounting bracket, and feet.

2.8 WEIGHT: 8 pounds

3.0 PANEL CONTROLS AND CONNECTIONS

3.1 General

3.1.01 This section describes the function of each switch, lamp and connector located on the front panel of the Model T247 Calibration Checker. Figure 3-1 will identify the items of the text by the designation numbers appearing on the schematic diagram.

3.2 Power Related Controls and Connections

3.2.01 ac power receptacle — This is a 3-prong male plug (J1) recessed behind the front panel located in the lower right corner. The line cord supplied with the test set supplies 115V ac power to the test set through this connection.

3.2.02 C.O. BATT jack — This 310-type jack (J2), located in the lower right section of the panel, is used to power the test set from 48V dc office battery. The dc voltage (of either polarity) is applied between the Tip and Sleeve of the jack.

3.2.03 1/2 AMP Fuse — The twist-lock fuse holder (XF1) is located to the left of the C.O. BATT jack. This 1/2 ampere fuse provides ac protection to the test set. When replacing this Fuse, do not exceed the 1/2 ampere rating.

3.2.04 Power Switch — This PUSH ON-OFF switch (S1) and integral lamp (DS1) is located in the lower center section of the panel. When using 115V ac power, the switch performs the ON-OFF function to apply power to the test set. When using 48V dc power the switch is not used. The lamp indicates that power is applied to the set.

3.3 Function Related Controls and Connections

3.3.01 T136 LEADS: GRN, RED, YEL — These three binding posts, located in the lower left section of the panel, provide the connecting points for the clip leads of the T136 being tested.

3.3.02 CLIP LEADS — This pair of alligator clips, labeled TO T136 DIAL POSTS, provides the resistance equivalent to lineman's handset for the LOOP mA measurement in certain T136 Models.

3.3.03 FROGGING: REVERSE, NORMAL — This switch, located above the binding posts, interchanges the internal electrical connections to the GRN and RED binding posts.

3.3.04 FUNCTION Switch — This switch (S5) is located in the left center of the panel. This switch selects the function of the T136 to be tested. The internal connections to the binding posts are switched to provide the proper signal configuration for the individual functions.

3.3.05 O.K. Lamp — This lamp (DS3), when illuminated, verifies the continuity of the DIAL function of the T136.

3.3.06 HOLD COIL GOOD Lamp — This lamp (DS2), when illuminated, verifies the continuity of the T136 hold coil in the CKT LOSS, CKT NOISE, and PWR INFL functions.

3.3.07 HUM REJECT TEST Pushbutton — This pushbutton switch (S2) adds a 180 Hz interference tone in the CKT LOSS function to verify the low frequency reject characteristic of the T136.

3.3.08 TEST FREQUENCY Hz Switch — This switch (S4), is located in the right center of the panel. This switch selects one of five fixed internal oscillator frequencies to be applied to the T136 for verification of its frequency response or weighting characteristic.

3.3.09 LEVEL Switch — This switch (S3), located in the right center of the panel, selects the reference level in 1000 Hz for the CKT LOSS, CKT NOISE, and PWR INFL functions. The REF (reference) level for each function is indicated on the panel.

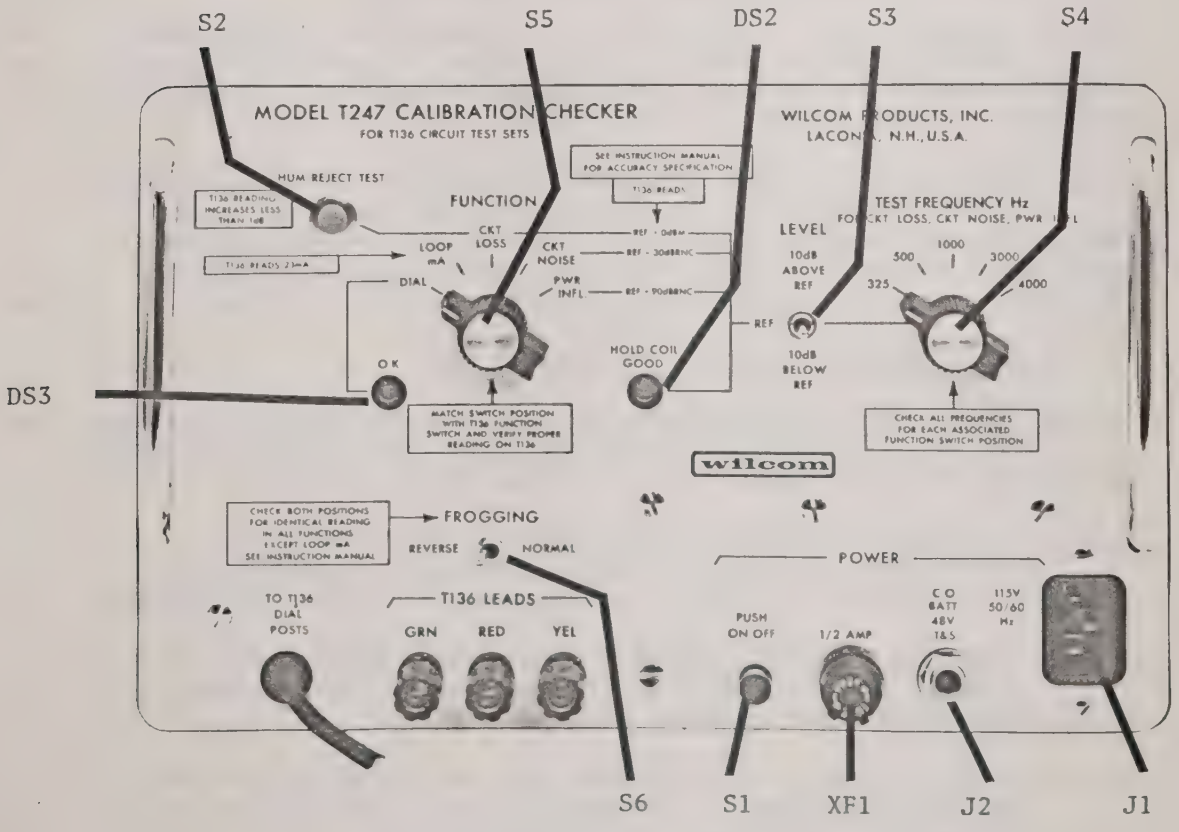

FIGURE 3-1 Panel Controls and Connections

4.0 OPERATING INSTRUCTIONS

4.1 Power

4.1.01 For operation, connect the line cord, supplied with the set, to the recessed male connector on the front panel. The other end may be plugged into any 115 volt three-wire convenience outlet. Power is supplied to the test set by pushing the POWER, PUSH ON-OFF switch. The integral lamp indicates that power is being supplied to the test set.

4.1.02 The Test Set may also be powered by 48V dc office battery applied between the tip and sleeve of a 310 type jack. When using 48V dc power, the PUSH ON-OFF switch is not part of the circuit. Power is supplied to the test set and the lamp when the 48V dc is connected to the C.O. BATT jack.

NOTE: When using 48V dc office battery for power, connect the 48V patch cord to the T247 C.O. BATT jack first and then connect to the 48V dc source.

4.2 Test Set-up

4.2.01 Set the T136 Circuit Test Set FUNCTION switch to the BATT TEST position. Push the PUSH TO MEAS button and observe a meter reading in the GOOD BATT portion of the scale. Replace the batteries if required.

4.2.02 Connect the clip leads of the T136 (RED, GRN, and YEL) to the binding post on the T247 identified by the same color.

4.2.03 Connect the T247 clip leads identified TO T136 DIAL POSTS to the dial posts of the T136 Circuit Test Set.

4.2.04 Set the T247 Controls as follows:

1)	FUNCTION	DIAL
2)	LEVEL	REF
3)	TEST FREQUENCY Hz	1000
4)	FROGGING	NORMAL
5)	POWER	ON

4.2.05 Set the T136 FUNCTION switch to the DIAL position.

NOTE: The T247 and T136 are now set-up to perform the first functional check, for DIAL operation. The checks for the remaining four functions and for the range extenders should be performed sequentially to insure the correct positioning of all switches.

4.3 Test Procedure

4.3.01 DIAL Check —

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Complete Test set-up 4.2.	O.K.: LED illuminates.	—

4.3.02 LOOP mA Check —

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Set the T247 FUNCTION switch to the LOOP mA position.	—	—
2	Set the T136 FUNCTION switch to the LINE mA/ LOOP mA position.	The T136 meter indicates 23 mA.	±2.8 mA
3	Set FROGGING switch to the REVERSE position.	The T136 Meter indicates 23 mA for the following test sets: T136BSB, T136BSC, T136BPT.	±2.8 mA
		The T136 meter pegs against the left pin for the following test sets: T136B, T136B-1, T136B-2, T136BC, T136BF, T136BNY, T136U-04.	—
4	Return FROGGING switch to the NORMAL position.	—	—
5	For T135U-04 only. Press the PUSH FOR mA X2 button on the T136.	The T136 meter indicates 11.5 mA.	±3.8 mA

4.3.03 CKT LOSS Check — All T136's except T136U-04.

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Set the T247 and the T136 FUNCTION switches to the CKT LOSS pos.	HOLD COIL GOOD: LED illuminates.	—
2	Press the T136 PUSH TO MEAS button.	The T136 meter indicates 0 dBm.	±0.2 dB *
3	Repeat step 2 for each position of the T247 TEST FREQUENCY Hz switch.	The T136 meter indicates 0 dBm at each freq.	±0.6 dB
4	Set the FROGGING switch to the REVERSE position.	—	—
5	Repeat step 3.	The T136 meter indicates 0 dBm at each freq.	±0.6 dB
6	Return the TEST FREQ. Hz switch to the 1000 pos. and the FROGGING switch to the NORMAL position.	—	—
7	While holding the T136 PUSH TO MEAS button, press the T247 HUM REJECT TEST button.	The T136 meter reading increases 0.5 dB.	±0.5 dB

*NOTE: If this tolerance is not met, it is possible to adjust the gain of the T136 Test Set to set the meter pointer on zero. Refer to Section 6.2 (LEVEL CALIBRATION) of the T136 Instruction Manual.

4.3.04 CKT LOSS Check — T136U-04 only. See previous section for other T136's.

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Set the T247 and the T136 FUNCTION switches to the CKT LOSS pos.	HOLD COIL GOOD: illuminates.	—
2	Set the T247 LEVEL switch to the 10 dB BELOW REF position. Press the T136 PUSH TO MEAS button.	The T136 meter indicates 10 dBm of CKT LOSS.	±0.2 dB *
3	Press the T136 PUSH TO MEAS button for each position of the T247 TEST FREQUENCY Hz switch.	The T136 meter indicates 10 dBm of CKT LOSS at each frequency.	±0.6 dB
4	Set the FROGGING switch to the REVERSE position.	—	—
5	Repeat step 3.	The T136 meter indicates 10 dBm of CKT LOSS at each frequency.	±0.6 dB
6	Return the TEST FREQ. Hz switch to the 1000 position and the FROGGING switch to the NORMAL pos.	—	—
7	While holding the T136 PUSH TO MEAS button, press the T247 HUM REJECT TEST button.	The T136 meter reading increases 0.5 dB.	±0.5 dB
8	Return the T247 LEVEL switch to the REF position.	—	—

*NOTE: If this tolerance is not met, it is possible to adjust the gain of the T136 Test Set to set the meter pointer on zero. Refer to Section 6.2 (LEVEL CALIBRATION) of the T136 Instruction Manual.

4.3.05 Range Extender Check — For T136BSB, T136BSC, T136BPT Test Sets. See following sections for other T136's.

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Press both the T136 PUSH TO MEAS and +10 dB buttons.	The T136 meter indicates -10 dBm.	±1 dB
2	Set the T247 LEVEL switch to the 10 dB ABOVE REF position. Press both the T136 PUSH TO MEAS and +10 dB buttons.	The T136 meter indicates 0 dBm.	±0.5 dB
3	Set the T247 LEVEL switch to the 10 dB BELOW REF position. Press both the T136 PUSH TO MEAS and -10 dB buttons.	The T136 meter indicates 0 dBm.	±0.5 dB
4	Return the T247 LEVEL switch to the REF position.	—	—

4.3.06 Range Extender Check — For T136B, T136B-2, T136BC, T136BNY only. See sections 4.3.05, 4.3.07, 4.3.08 for other T136's.

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Set the T247 LEVEL switch to the 10 dB ABOVE REF position.	—	—
2	Press both the PUSH TO MEAS and the ADD 20 dB buttons on the T136.	The T136 meter indicates -10 dBm.	±1 dB
3	Return the LEVEL switch to the REF position.	—	—

4.3.07 Range Extender Check — For T136BF, T136U-04 only. See sections 4.3.05, 4.3.06, 4.3.08 for other T136's.

	STEP	WHAT TO DO	RESULT	TOLERANCE
T136BF Only	1	Press both the PUSH TO MEAS and the ADD 10 dB buttons on the T136.	The T136 meter indicates -10 dBm.	±1 dB
	2	Set the T247 LEVEL switch to the 10 dB ABOVE REF position.	—	—
	3	Press both the PUSH TO MEAS and the ADD 10 dB buttons on the T136.	The T136 meter indicates 0 dBm.	±0.5 dB
	4	Return the T247 LEVEL switch to the REF position.	—	—

4.3.08 Range Extender Check — For T136B-1 only. See sections 4.3.05, 4.3.06, 4.3.07, for other T136's.

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Set the T247 LEVEL switch to the 10 dB BELOW REF position.	—	—
2	Press the PUSH TO MEAS button on the T136.	The T136 meter indicates -10 dBm.	±1 dB
3	Press both the PUSH TO MEAS and the -10 dBm TO -20 dBm buttons on the T136.	The T136 meter indicates 0 dBm.	±0.5 dB
4	Set the T247 LEVEL switch to the 10 dB ABOVE REF position.	—	—
5	Press both the PUSH TO MEAS and the ADD 20 dB buttons on the T136.	The T136 meter indicates -10 dBm.	±1 dB
6	Return the T247 LEVEL switch to the REF position.	—	—

4.3.09 CKT NOISE Check —

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Set the T247 and the T136 FUNCTION switches to the CKT NOISE pos.	HOLD COIL GOOD: illuminates.	—
2	Press the T136 PUSH TO MEAS button.	The T136 meter indicates 30 dBrnc.	±0.3 dB *
3	Repeat step 2 for each position of the T247 TEST FREQUENCY Hz switch.	The T136 meter indicates 30 dBrnc. at each frequency.	325 Hz: ±1.8 dB 500 Hz: ±1.8 dB 1000 Hz: ±0.3 dB 3000 Hz: ±2.8 dB 4000 Hz: ±3.8 dB
4	Set the FROGGING switch to the REVERSE position.	—	—
5	Repeat step 2 for each position of the T247 TEST FREQUENCY Hz switch.	The T136 meter indicates 30 dBrnc at each frequency.	325 Hz: ±1.8 dB 500 Hz: ±1.8 dB 1000 Hz: ±0.3 dB 3000 Hz: ±2.8 dB 4000 Hz: ±3.8 dB
6	Return the TEST FREQ. Hz switch to the 1000 position and the FROGGING switch to the NORMAL pos.	—	—

*NOTE: If this tolerance is not met, it is possible to adjust the gain of the T136 Test Set to set the meter pointer on zero. Refer to Section 6.2 (LEVEL CALIBRATION) of the T136 Instruction Manual.

4.3.10 PWR INFL Check —

STEP	WHAT TO DO	RESULT	TOLERANCE
1	Set the T247 and the T136 FUNCTION switches to the PWR INFL pos.	HOLD COIL GOOD: illuminates.	—
2	Press the T136 PUSH TO MEAS button.	The T136 meter indicates 90 dBrnc.	±1.2 dB
3	Repeat step 2 for each position of the T247 TEST FREQUENCY Hz switch.	The T136 meter indicates 90 dBrnc at each frequency.	325 Hz: ±2.5 dB 500 Hz: ±2.5 dB 1000 Hz: ±1.2 dB 3000 Hz: ±3.5 dB 4000 Hz: ±4.5 dB
4	Set the FROGGING switch to the REVERSE position.	—	—
5	Repeat step 2 for each position of the T247 TEST FREQUENCY Hz switch.	The T136 meter indicates 90 dBrnc at each frequency.	325 Hz: ±2.5 dB 500 Hz: ±2.5 dB 1000 Hz: ±1.2 dB 3000 Hz: ±3.5 dB 4000 Hz: ±4.5 dB
6	Return the TEST FREQUENCY Hz switch to the 1000 position and the FROGGING switch to the NORMAL position.	—	—

4.4 Test Failure — If the T136 fails to operate or meet a specific tolerance of the Test Procedures, the T136 should be calibrated or repaired, as required.

5.0 CIRCUIT DESCRIPTION

5.1 General

5.1.01 This section describes the T247's internal circuits and their functions. Signal flow is traced from the oscillator to the output.

5.1.02 A detailed schematic diagram of the T247 is shown in Figure 7-1. Reference designations in this section indicate corresponding components on Figure 7-1.

5.2 Main Oscillator Circuit

5.2.01 The basic oscillator consists of the integrated circuit U4A with feedback elements. Each of the five fixed frequencies has a separate RC tuning section with an IC buffer amplifier (U1,U2,U3). If U4A were connected unity gain (pin 1 connected directly to pin 2), the circuit would be a resonator with resonant frequency equal to $1/2 \cdot \pi \cdot (R102 + R101) \cdot R103 \cdot C101 \cdot C102$. In the actual circuit, the negative feedback from pin 1 to pin 2 is reduced slightly by a voltage divider consisting of R62 in parallel with Q10 for the series leg and R63 for the shunt leg. This makes the non-inverting amplifier gain slightly greater than unity. The increase in gain is sufficient to increase the Q of the resonator to the point where it becomes unstable and breaks into oscillation at the resonant frequency.

5.2.02 The oscillator output is isolated by U4B and then taken to a precision rectifier circuit, U5A. The rectified output voltage and a reference voltage from VR3 are converted to currents and summed at pin 5 of U5B. The difference between the signal current and reference current is amplified in U5B and applied to the gate of Q10 to control the non-inverting gain of U4A. The non-inverting gain of U4A is thereby controlled at the precise value required to produce oscillation at the required output level.

5.2.03 Trimpot R53 provides for adjustment of the reference current to set the oscillator output level.

5.2.04 A trimpot provides fine adjustment for each of the five fixed frequencies that are individually selected by S4(TEST FREQUENCY Hz).

5.3 Hum Test Oscillator Circuit

5.3.01 The 180 Hz hum test signal is generated by a one transistor (Q5) RC oscillator. The frequency of oscillation is set by the requirement for 180° of phase shift in the high pass network between the collector and base of Q5. Each of three RC networks (the input impedance of Q5 provides the third resistance) provides 60° of phase shift at 180 Hz. Trimpot R11 provides a fine adjustment for the oscillator frequency.

5.4 Level Control Circuits

5.4.01 Amplifier U6B provides isolation for the two oscillators and acts as a differential amplifier when both signals are required for the HUM REJECT function test.

5.4.02 Trimpot R15 provides adjustment to set the 180 Hz hum test signal to a level 1.5 dB below the main oscillator level.

5.4.03 Resistor voltage divider R19,20,21 and switch S3 (LEVEL) provide three voltage levels, with 10 dB steps, for the input of amplifier U6A.

5.4.04 Amplifier U6A provides additional signal gain, 10 dB, and isolates the 10 dB level adjustment from the resistor dividers which set the levels required by the different T247 functions.

5.4.05 The correct reference level for CKT LOSS is independent of frequency and is therefore set by resistor divider R32,33. The level is such that when the T247 and T136 FUNCTION switches are in the CKT LOSS position, the T136 will indicate the level selected by the T247 LEVEL switch (REF = 0 dBm).

5.4.06 The correct reference level for PWR INFL is frequency dependent due to the C-Message weighting characteristic. One pole of switch S4(TEST FREQUENCY Hz) is used to select the correct resistance (R25-R30) in proportion to the R23,24 combination to set the reference level versus frequency to the inverse of the C-Message weighting. The level is such that when the T247 and T136 FUNCTION switches are in the PWR INFL position, the T136 will indicate the level selected by the T247 LEVEL switch (REF = 90 dBrnc) for all five frequencies.

5.4.07 The CKT NOISE reference level is also frequency dependent and is set by attenuating the power influence level an additional 60 dB in resistor divider R31,34,35. The level is such that when the T247 and T136 FUNCTION switches are in the CKT NOISE position, the T136 will indicate the level selected by the T247 LEVEL switch (REF = 30 dBrnc) for all five frequencies.

5.5 Output Amplifier Circuit

5.5.01 The output amplifier, U7 and Q6 thru Q9, provides the additional gain required to obtain the required voltages at the T247 output. The amplifier and transformer T2, combined, provide 18 dB of gain.

5.6 HOLD COIL GOOD CIRCUIT

5.6.01 The dc path through the T136 hold coil provides current flow from the circuit common at S5A through R64 and R66 to the minus supply voltage. Transistor Q11 is then turned on to light the LED.

5.7 Power Supply

5.7.01 The power supply provides two zener derived voltages from the 48 Vdc office battery. When using ac power, transformer T1 provides approximately 43 Vac which is rectified to obtain the 48 Vdc.

5.7.02 Transistors Q2 and Q4 are the series pass transistors for the -11V and -29V dc supplies respectively. If the current exceeds 30 mA for the -11V supply or 100 mA for the -29V supply, transistor Q1 or Q3 begins to conduct and thereby shunts the base current for the pass transistors to limit the output current.

6.0 MAINTENANCE — TROUBLE LOCATING

6.1 General

6.1.01 All Wilcom Products, Inc. test equipment is warranted against defects in materials and workmanship for a period of one year from the date of delivery. Complete details of the warranty can be found on the title page of this manual.

6.1.02 Field repair of this calibration set is NOT recommended unless the repair will be made in a well equipped repair center. The technician performing the repair should be familiar with integrated circuitry, and state of the art semiconductor design.

6.1.03 In the event of troubles, reference should be made to the repair procedure of section 6.2 and the circuit descriptions of section 5. Performing the alignment procedure of section 6.3 should give a good indication of the trouble location. A technician with an understanding of the circuit functions should be able to trace signals and locate and repair any fault which may occur.

6.1.04 If local repair is not possible, it is suggested that the complete calibration set be returned for repair with information regarding the suspected trouble.

6.1.05 After any repairs not made by Wilcom Products, Inc. the calibration set should be re-aligned following the procedures of section 6.3.

6.2 Repair Procedure

6.2.01 Remove the Calibration Set from its case by unlocking the two DZUS fasteners on the rear of the case. Grasp the Set by the front panel handles and pull it from the case.

6.2.02 A good visual inspection may give a quick solution to the problem. Look for loose solder connections or component parts which have been jarred loose or broken, or any other visual clues.

6.2.03 Basic Functional Checks

1. Apply ac power to the test set — see Section 4.1.01.

2. Using a dc voltmeter (observe capacitor polarity) check for 11.3V ±.8V dc across C4 and 29.25V ±1.75V across C5.

3. Set the T247 controls as follows:

Control Designation	Position
FUNCTION	CKT. LOSS
LEVEL	REF.
TEST FREQUENCY Hz	1000

4. Connect a 735 ohm resistor between the binding posts labeled GRN and RED.

5. Using a high impedance ac voltmeter and frequency counter, verify the presence of approximately .87V rms at 1000 Hz across the GRN and RED binding posts.

6.3 Alignment and Calibration

6.3.01 General

1. This section provides information needed to align the Model T247 Calibration Checker and verifies the proper operation of the Calibration Set. Alignment information covers adjustments which can be made by field personnel, using standard test equipment.

2. The Basic Functional Checks in Section 6.2.03 should be performed BEFORE any attempt is made to calibrate the set. Malfunctions uncovered should be repaired prior to completion of this procedure.

3. Applying Power — To eliminate repetitive instructions, it is assumed that power will be removed from the Calibration Set during all disassembly or assembly operations and reapplied prior to testing. Allow 5 minutes for circuit to stabilize each time power is applied.

4. The Calibration Set should be removed from its case before starting the Alignment and Calibration procedure. See Section 6.2.01.

5. An alignment check sheet should be completed during this procedure.

6.3.02 Equipment Required

1. Electronic ac voltmeter or Level Meter accurate to within ±.005 dB @ 1000 Hz and ±.1 dB at other frequencies from 50 Hz to 20 kHz.

2. Digital Multimeter — VOM

3. Frequency Counter

4. General Purpose Oscilloscope

6.3.03 dc Checks and Calibration

1. With an ohmmeter check for approximately 226 ohms between the two clip leads labeled TO T136 DIAL POSTS.

2. Place the FROGGING switch in the NORMAL position and the FUNCTION switch in the DIAL position. Connect a 200 ohm resistor and a dc current meter in series across the GRN (+) and RED (-) binding posts.

3. The LED labeled DIAL-O.K. should be illuminated; the current meter should read 16 mA ±3 mA.

4. Place the FROGGING switch in the REVERSE position. The current meter should read the same magnitude as noted in step 3 above except negative polarity.

5. Place the FUNCTION switch in the LOOP mA position. The current meter should read 23 mA ±.7 mA.

NOTE: R50 (approx. 1K) is factory selected and should not require changing. However, R50 may be padded or replaced to achieve the desired accuracy noted in step 2 above.

6.3.04 CKT. LOSS Calibration

1. Establish the test set-up of Figure 6-1 and set the T247 controls as follows:

Control Designation	Position
FUNCTION	CKT. LOSS
LEVEL	REF.
TEST FREQUENCY Hz	1000
FROGGING	NORMAL

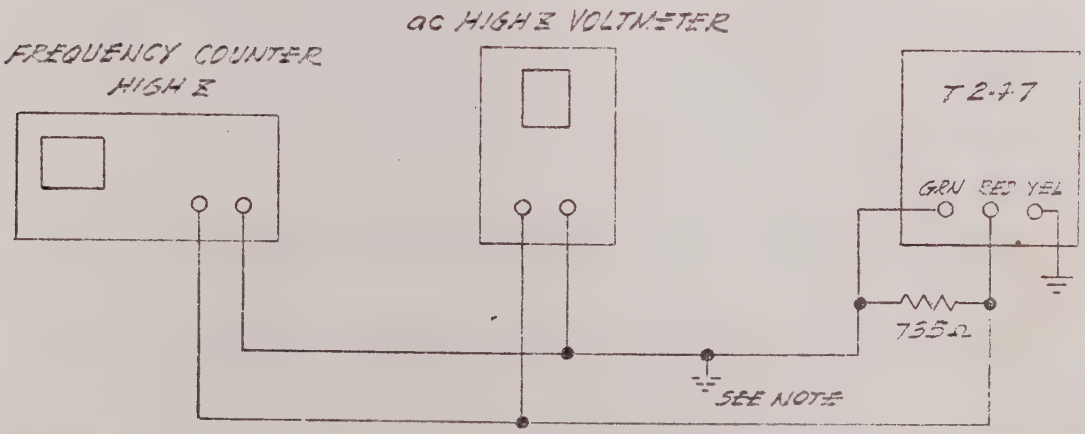

FIGURE 6-1

NOTE: GRN side of T247 input is ground when FROGGING switch is in the NORMAL position. RED side is ground when FROGGING switch is in the REVERSE position. Maintain proper ground polarities when using a single-ended voltmeter.

2. The HOLD COIL GOOD "LED" should be illuminated with a 735 ohm resistor across the GRN and RED binding posts.

3. Tune the 100 Hz ADJ. (R302) on the MAIN P.C. ASSEMBLY, Figure 7-2, for 1000 Hz on the frequency counter shown in Figure 6-1.

4. Tune the LEVEL ADJ. (R53) Figure 7-2 for .857V rms on the voltmeter shown in Figure 6-1.

6.3.05 LEVEL Switch Check

1. Set the LEVEL switch to 10 dB ABOVE REF. The voltmeter should read 2.711V rms ±.031V rms.

2. Set the LEVEL switch to 10 dB BELOW REF. The voltmeter should read .271V rms ±.003V rms.

6.3.06 TEST FREQUENCY Hz Calibration

1. Set the LEVEL switch to REF. and the TEST FREQUENCY Hz switch to 325.

2. Tune the 325 Hz ADJ. (R102) Figure 7-2 for 325 Hz on the frequency counter, Figure 6-1.

3. Repeat steps 1 and 2 for the other four TEST FREQUENCY Hz positions. Tune the corresponding adjustment of the MAIN P.C. ASSEMBLY, Figure 7-2, for the frequency indicated by the range selected.

NOTE: R101 thru R501 are factory selected. Component changes should not be necessary. However, typical values are noted on the Figure 7-2 assembly drawing and Figure 7-1 Calibration Checker (schematic) drawings. Values may be altered slightly to achieve the proper frequencies.

6.3.07 HUM REJECT TEST Check

1. Place a short from the negative of C4 to the junction of R53 and R54. This disables the main oscillator.

2. Press and hold the HUM REJECT TEST momentary pushbutton. Tune the HUM FREQ (R11) Figure 7-2 for 180 Hz. Tune the HUM LEVEL (R15) for .721V rms.

NOTE: If the HUM LEVEL adjustment is tuned too close to ground the 180 Hz oscillator will not oscillate.

3. Release the HUM REJECT momentary pushbutton. Remove the short from C4 and R53-R54.

6.3.08 PWR. INFL. Calibration

1. Set the FUNCTION switch to PWR. INFL. and the TEST FREQUENCY Hz switch to 1000. Remove the 735 ohm resistor from the GRN and RED terminals.

2. Measure the signal level at the RED and the YEL (Gnd) binding posts. It should be approximately .775V rms.

3. Place the FROGGING switch in REVERSE; the signal level should not change.

4. Connect a short between the GRN and RED binding posts. Measure the signal level from the GRN or RED binding post to YEL (Gnd) binding post.

5. Select R23 Figure 7-2 (if necessary) to achieve a .775V rms signal level.

6.3.09 CKT. NOISE Calibration

1. Replace the short across the GRN and RED binding posts with a 735 ohm precision resistor. Set the T247 controls as follows:

Control Designation	Position
FUNCTION	CKT. NOISE
TEST FREQUENCY Hz	1000
FROGGING	NORMAL

2. Measure the signal level on the GRN and RED binding posts (refer to Figure 6-1). Select R31 (if necessary) for 857 µVrms as read on the voltmeter.

3. Set the TEST FREQUENCY Hz switch to 500. Select R30 (if necessary) for 2.033 mVrms.

4. Set the TEST FREQUENCY Hz switch to 4000. Select R26 (if necessary) for 4.551 mVrms.

5. Set the TEST FREQUENCY Hz switch to each of the positions shown below to verify the corresponding voltmeter readings.

TEST FREQUENCY Hz	Voltmeter Reading
325	4.821 mV $^{+.17\ mV}_{-.16\ mV}$
3000	1.143 mV ±.04 mV

6.3.10 PWR. INFL. CHECK

1. Set the FUNCTION switch to PWR. INFL. Connect a short between the GRN and RED binding posts. Measure the voltage from the GRN or RED binding post to the YEL (Gnd) binding post.

2. Set the TEST FREQUENCY Hz switch to each of the positions shown below to verify the corresponding voltmeter readings.

TEST FREQUENCY Hz	Voltmeter Reading
325	4.356 Vrms +.258 Vrms -.244 Vrms
500	1.837 Vrms +.109 Vrms -.103 Vrms
1000	.775 Vrms ±.018 Vrms
3000	1.033 Vrms +.061 Vrms -.058 Vrms
4000	4.112 Vrms +.244 Vrms -.230 Vrms

6.3.11 External 48V Supply Check

1. The test set may also be powered by 48V dc office battery. Refer to section 4.1.02 for details.

2. Repeat section 6.2.03 step 2 for a dc voltage check.

NOTE: When using 48V dc office battery for power, connect the 48V patch cord to the T247 C.O. BATT jack first and then connect to the 48V dc source.

T247 ALIGNMENT CHECK SHEET

Basic Functional Checks

11 Vdc_____Vdc (11.3V ±.8 Vdc)

29 Vdc_____Vdc (29.25V ±1.75 Vdc)

Oscillator output_____O.K.

d.c. Checks and Calibration

TO T136 DIAL POSTS_____ohms (226 ±2.3 ohms)

DIAL O.K. "LED"_____.

DIAL_____(16 mA ±3 mA)

FROGGING Switch_____

LOOP mA_____(23 mA ±.7 mA)

CKT. LOSS Calibration

HOLD COIL GOOD "LED"_____

1000 Hz ADJ._____ LEVEL ADJ._____

LEVEL Switch Check

10 dB ABOVE REF._____ 10 dB BELOW REF._____

TEST FREQUENCY Hz Calibration

325 Hz ADJ._____ 3000 Hz ADJ._____
500 Hz ADJ._____ 4000 Hz ADJ._____
1000 Hz ADJ._____

HUM REJECT TEST Calibration

HUM FREQ Adj_____ HUM LEVEL Adj_____

FROGGING Switch Check

Good_____

PWR. INFL. Calibration

.775 Vrms_____ R23_____

CKT. NOISE Calibration

1000 Hz_____	857 µVrms	+10 µVrms -9.8 µVrms	R31_____
500 Hz_____	2.033 mVrms	±.07 mVrms	R30_____
4000 Hz_____	4.551 mVrms	+.16 mVrms -.115 mVrms	R26_____
325 Hz_____	4.821 mVrms	+.17 mVrms -.16 mVrms	
3000 Hz_____	1.143 mVrms	±.04 mVrms	

PWR. INFL. Check

325 Hz_____	4.356 Vrms	+.258 Vrms -.244 Vrms
500 Hz_____	1.837 Vrms	+.109 Vrms -.103 Vrms
1000 Hz_____	.775 Vrms	±.018 Vrms
3000 Hz_____	1.033 Vrms	+.061 Vrms -.058 Vrms
4000 Hz_____	4.112 Vrms	+.244 Vrms -.230 Vrms

C.O BATT. Check

29 Vdc_____(29.25V ±1.75 Vdc)

11 Vdc_____(11.3V ±.8 Vdc)

7.0 SCHEMATIC AND LAYOUT DRAWINGS

7.1 General

7.1.01 The following pages provide the illustrations useful in locating and identifying the component parts that make up the Model T247 Calibration Checker.

7.1.02 The necessary schematic diagram and layout drawing of the printed circuit assembly are given to allow identification of various components, controls and terminals on the circuit board. This information will be useful to those with the facilities to provide maintenance and calibration of this test equipment.

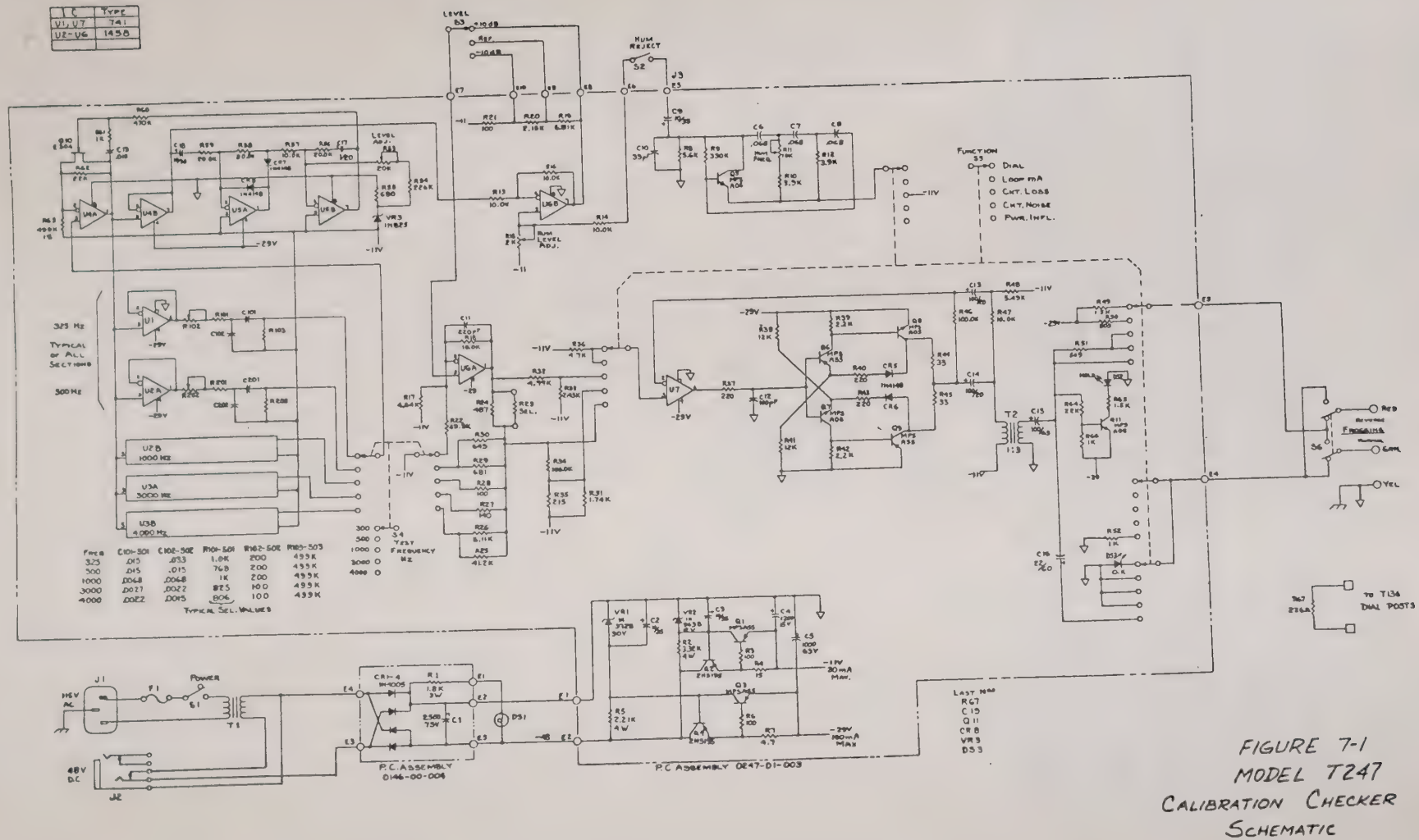

FIGURE 7-1
MODEL T247
CALIBRATION CHECKER
SCHEMATIC

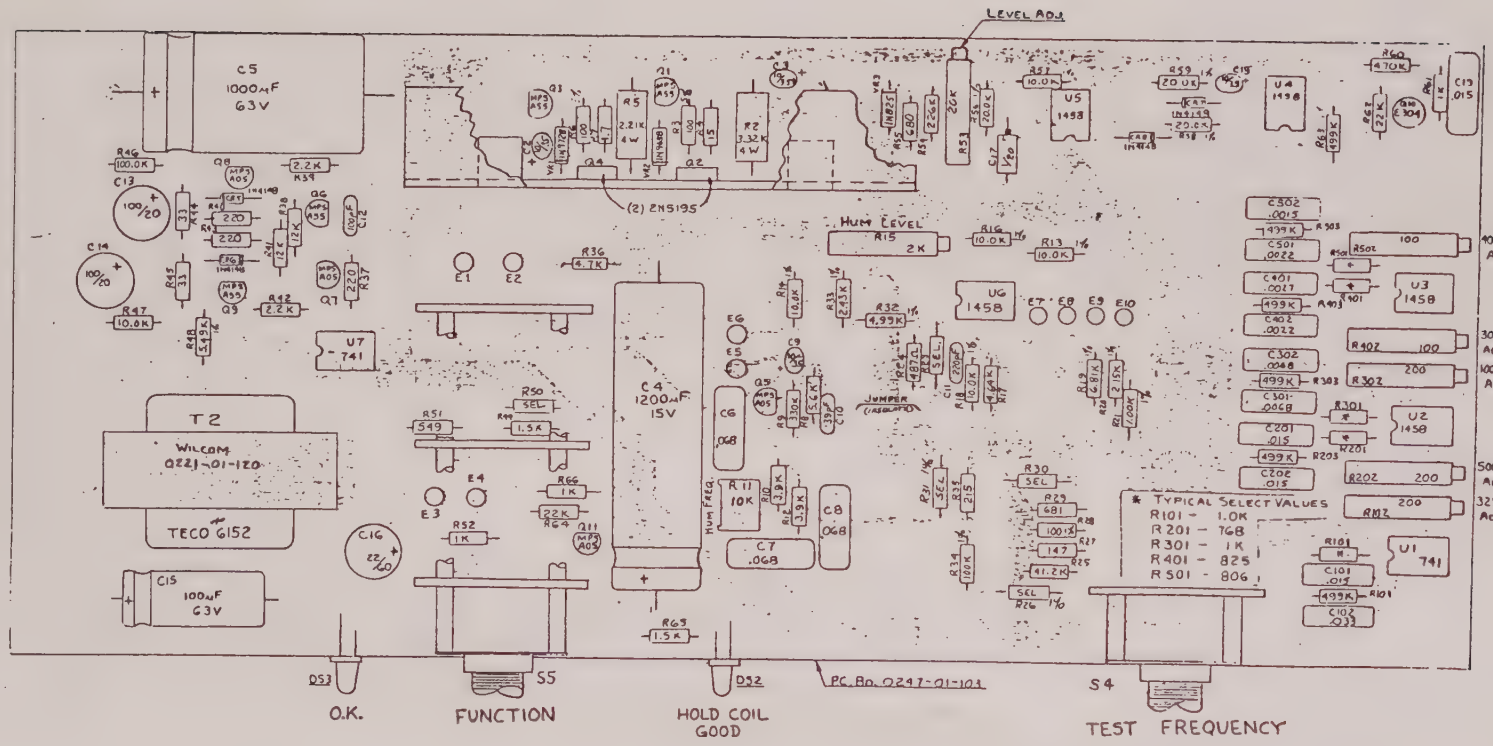

FIGURE 7-2
MAIN P.C. ASSEMBLY

8.0 PARTS LIST

8.1 General

8.1.01 The Parts Lists provided on the following pages supply the description of the various assemblies, sub-assemblies and components that make up the Model T247 Calibration Checker.

8.1.02 For those components purchased by Wilcom, the manufacturer and manufacturer's part number are provided. Those components manufactured by Wilcom are identified by a Wilcom part number..

8.1.03 Any required items may be ordered direct from Wilcom Products, Inc. or the manufacturer.

PARTS LIST

T247 CALIBRATION CHECKER FOR T136 CIRCUIT TEST SETS (0247-01-900)

Ref. Desig.	Description	Qty.	Mfr.	Manufacturer's Number
	PANEL ASSEMBLY	1	Wilcom	0247-01-001
	CASE ASSEMBLY	1	Wilcom	0247-01-099
	COVER ASSEMBLY	1	Wilcom	0265-01-098
	POWER CORD	1	Belden	17250
	OPERATING INSTRUCTION MANUAL	1	Wilcom	06801054
	SERVICE MANUAL	1	Wilcom	06802672

PARTS LIST

COVER ASSEMBLY (0265-01-098)

Ref. Desig.	Description	Qty.	Mfr.	Manufacturer's Number
	COVER	1	Wilcom	0265-01-198
	HINGE	1	Nielson	3518 NE
	HINGE	1	Nielson	3519 NE
	STRIKE	2	Zero	ZSP2-220-3

PARTS LIST

CASE ASSEMBLY (0247-01-099)

Ref. Desig.	Description	Qty.	Mfr.	Manufacturer's Number
	CASE	1	Wilcom	0247-01-199
	HANDLE	1	Wilcom	0051-00-132
	HANGER BRACKET	1	Wilcom	0247-01-102
	RUBBER FEET	8	Russell	2096-S
	STUD	2	Simmons	#02
	HINGE	2	Nielson	#3517NE
	CATCH	2	Zero	#ZSP2-220-2

PARTS LIST

PANEL ASSEMBLY (0247-01-001)

Ref. Desig.	Description		Qty.	Mfr.	Manufacturer's Number
	PANEL		1	Wilcom	0247-01-101
	P.C. ASSEMBLY		1	Wilcom	0247-01-003
	P.C. ASSEMBLY, Rectifier		1	Wilcom	0146-00-004
	CONNECTING LEAD ASSEMBLY		1	Wilcom	0247-01-009
	BRACKET ASSEMBLY		1	Wilcom	0247-01-007
	BRACKET ASSEMBLY		1	Wilcom	0247-01-008
	BRACKET		1	Wilcom	0274-01-113
	BOOT		1	Wilcom	0051-00-133
T1	TRANSFORMER (TECO 5746)		1	Wilcom	0146-00-102
C1	CAPACITOR, Elect., 75V	2500 µF	1	Sprague	36D252G075AC2A
R67	RESISTOR, ±1%, 1/4W	226 ohm	1	TRW/IRC	T055
S1	SWITCH		1	Marco Oak	616
S2	SWITCH		1	Switchcraft	903
S3	SWITCH, Toggle, DP3T		1	Alco	MTA-206PA
S6	SWITCH, Toggle, DPDT		1	Alco	MTA-206N
	JACK		1	Switchcraft	JJ-082
	RECEPTACLE		1	Switchcraft	EAC-301
	HANDLE		2	BUD	H9111
	LAMP	1/2 A-250V	1	C.M.L.	327
	FUSE		1	Littelfuse	312.500
	FUSEHOLDER		1	Bussman	HTA
	CLAMP		1	Mallory	CMC-22-VR3
	KNOB		2	Buckeye	PS70BL-2
	TERMINAL STRIP		1	H.H. Smith	830
	SOLDER LUG		1	H.H. Smith	1414-6
	SOLDER LUG		2	H.H. Smith	1414-10
	BINDING POST		3	Grayhill	29-1R
	HEAT SHRINK TUBING	3-1/2"	1	Alpha	FIT 221 x 3/4
	GROMMET, Rubber		1	G.C. Elect.	GC1042M
	LOCKWASHER, Helical spring #8		1		
	WASHER, Nylon #4		2	Amatom	2202-N116
	WASHER, Nylon #6		5	Amatom	2203-N129

PARTS LIST

P.C. ASSEMBLY, CALIBRATION CHECKER FOR T136 TEST SET (0247-01-003)

Ref. Desig.	Description		Qty.	Mfr.	Manufacturer's Number
	P.C. BOARD		1	Wilcom	0247-01-103
R28	RESISTOR, ±1%, 1/4W	100 ohm	1	TRW/IRC	T055
R27	RESISTOR, ±1%, 1/4W	147 ohm	1	TRW/IRC	T055
R35	RESISTOR, ±1%, 1/4W	215 ohm	1	TRW/IRC	T055
R24	RESISTOR, ±1%, 1/4W	487 ohm	1	TRW/IRC	T055
R51	RESISTOR, ±1%, 1/4W	549 ohm	1	TRW/IRC	T055
R30	RESISTOR, ±1%, 1/4W	649 ohm	1	TRW/IRC	T055

PARTS LIST

P.C. ASSEMBLY, CALIBRATION CHECKER FOR T136 TEST SET (0247-01-003) continued

Ref. Desig.	Description		Qty.	Mfr.	Manufacturer's Number
R29	RESISTOR, ±1%, 1/4W	681 ohm	1	TRW/IRC	T055
R21	RESISTOR, ±1%, 1/4W	1.00 k	1	TRW/IRC	T055
R33	RESISTOR, ±1%, 1/4W	2.43 k	1	TRW/IRC	T055
R17	RESISTOR, ±1%, 1/4W	4.64 k	1	TRW/IRC	T055
R32	RESISTOR, ±1%, 1/4W	4.99 k	1	TRW/IRC	T055
R48	RESISTOR, ±1%, 1/4W	5.49 k	1	TRW/IRC	T055
R19	RESISTOR, ±1%, 1/4W	6.81 k	1	TRW/IRC	T055
R20	RESISTOR, ±1%, 1/4W	2.15 k	1	TRW/IRC	T055
R13,14,16, 18,47,57	RESISTOR, ±1%, 1/4W	10.0 k	6	TRW/IRC	T055
R56,58,59	RESISTOR, ±1%, 1/4W	20.0 k	3	TRW/IRC	T055
R25	RESISTOR, ±1%, 1/4W	41.2 k	1	TRW/IRC	T055
R34,46	RESISTOR, ±1%, 1/4W	100.0 k	2	TRW/IRC	T055
R54	RESISTOR, ±1%, 1/4W	226 k	1	TRW/IRC	T055
R63,103,203, 303,403,503	RESISTOR, ±1%, 1/4W	499 k	6	TRW/IRC	T055
R23,101-501, 50,31,26	RESISTOR, ±1%, 1/4W	SEL	9	TRW/IRC	T055
R5	RESISTOR, ±1%, 4W	2.21 k	1	TRW/IRC	GS-3
R2	RESISTOR, ±1%, 4W	3.32 k	1	TRW/IRC	GS-3
R7	RESISTOR, ±5%, 1/4W	4.7 ohm	1	TRW/IRC	TF07
R4	RESISTOR, ±5%, 1/4W	15 ohm	1	TRW/IRC	RG-1/4
R44,45	RESISTOR, ±5%, 1/4W	33 ohm	2	TRW/IRC	RG-1/4
R3,6	RESISTOR, ±5%, 1/4W	100 ohm	2	TRW/IRC	RG-1/4
R37,40,43	RESISTOR, ±5%, 1/4W	220 ohm	3	TRW/IRC	RG-1/4
R55	RESISTOR, ±5%, 1/4W	680 ohm	1	TRW/IRC	RG-1/4
R52,61,66	RESISTOR, ±5%, 1/4W	1.0 k	3	TRW/IRC	RG-1/4
R49,65	RESISTOR, ±5%, 1/4W	1.5 k	2	TRW/IRC	RG-1/4
R39,42	RESISTOR, ±5%, 1/4W	2.2 k	2	TRW/IRC	RG-1/4
R10,12	RESISTOR, ±5%, 1/4W	3.9 k	2	TRW/IRC	RG-1/4
R8	RESISTOR, ±5%, 1/4W	5.6 k	1	TRW/IRC	RG-1/4
R38,41	RESISTOR, ±5%, 1/4W	12 k	2	TRW/IRC	RG-1/4
R62,64	RESISTOR, ±5%, 1/4W	22 k	2	TRW/IRC	RG-1/4
R9	RESISTOR, ±5%, 1/4W	330 k	1	TRW/IRC	RG-1/4
R60	RESISTOR, ±5%, 1/4W	470 k	1	TRW/IRC	RG-1/4
R36	RESISTOR, ±5%, 1/4W	4.7 k	1	TRW/IRC	RG-1/4
R402,502	POT, ±10%, 3/4W, 20 turn	100 ohm	2	Bourns	3009P-1-101
R102,202,302	POT, ±10%, 3/4W, 20 turn	200 ohm	3	Bourns	3009P-1-201
R15	POT, ±10%, 3/4W, 20 turn	2 k	1	Bourns	3009P-1-202
R11	POT, ±10%, 3/4W, 20 turn	10 k	1	Bourns	3389P-1-103
R53	POT, ±10%, 3/4W, 20 turn	20 k	1	Bourns	3009P-1-203
C12	CAPACITOR, Disc, ±5%, 500V	100 pF	1	Erie	851-000-U2J0-101J
C11	CAPACITOR, Disc, ±10%	220 pF	1	Erie	831-000-X5F0-221K
C10	CAPACITOR, Disc, ±5%, 500V	39 pF	1	Erie	800-000-U2J0-390J
C6,7,8	CAPACITOR, Mylar, ±10%	.068 µF	3	Sprague	225P68391WD3
C101,201, 202,19	CAPACITOR, Mylar, ±10%	.015 µF	4	Sprague	225P15391WD3

PARTS LIST

P.C. ASSEMBLY, CALIBRATION CHECKER FOR T136 TEST SET (0247-01-003) continued

Ref. Desig.	Description	Qty.	Mfr.	Manufacturer's Number
C102	CAPACITOR, Mylar, ±10%, .033 µF	1	Sprague	225P33391WD3
C402,501	CAPACITOR, Mylar, ±10%, .0022 µF	2	Sprague	225P22291WD3
C502	CAPACITOR, Mylar, ±10%, .0015 µF	1	Sprague	225P15291WD3
C401	CAPACITOR, Mylar, ±10% .0027 µF	1	Sprague	225P27291WD3
C301,302	CAPACITOR, Mylar, ±10% .0068 µF	2	Sprague	225P68291WD3
C4	CAPACITOR, Elect., 15V 1200 µF	1	Sprague	39D128G015FL4
C16	CAPACITOR, Elect., 60V 22 µF	1	Sprague	672D226H060CG5C
C13,14	CAPACITOR, Elect., 20V 100 µF	2	Sprague	672D107H020CG5C
C5	CAPACITOR, Alum. Elect., 1000 µF	1	Siemans	B41010
C15	CAPACITOR, Alum. Elect., 100 µF	1	Siemans	B41283
C17	CAPACITOR, Tant., ±10%, 20V 1 µF	1	Sprague	150D105X9020A2
C2,3,9,18	CAPACITOR, Tant., ±10%, 35V 10 µF	4	ITT	TAG-A10M35
T2	TRANSFORMER (TECO #6152)	1	Wilcom	0221-01-120
CR5,6,7,8	DIODE, Sil, Sm. Sig.	4		1N4148
VR1	DIODE, Zener, 30V	1		1N972B
VR2	DIODE, Zener, 12V	1		1N963B
VR3	DIODE, Zener, 6.2V	1		1N825
Q1,3,6,9	TRANSISTOR, PNP	4	Motorola	MPSA55
Q5,7,8,11	TRANSISTOR, NPN	4	Motorola	MPSA05
Q10	TRANSISTOR, JFET	1	Siliconix	E304
Q2,4	TRANSISTOR, PNP	2		2N5195
U2,3,4,5,6	IC, Dual Op Amp	5	Motorola	MC1458CP
U1,7	IC, Op Amp	2	Motorola	MC1741CP
S5	SWITCH, Rotary	1	Wilcom	0247-01-105
S4	SWITCH, Rotary	1	Wilcom	0247-01-106
DS2,3	DISPLAY	2	Fairchild	FLV-260
	HEAT SINK	1	Wilcom	0146-10-102
	TRANSISTOR MNT. KIT	2	Motorola	MK77-2

PARTS LIST

BRACKET ASSEMBLY (0247-01-007)

Ref. Desig.	Description	Qty.	Mfr.	Manufacturer's Number
	BRACKET, Panel Mounting Left	1	Wilcom	0247-01-107
	BRACKET	1	Keystone	631
	RIVET, Tubular, nickel plated	2	Acme	JT 218 x 3/16
	RECEPTACLE	1	Simmons	P2-13

PARTS LIST

BRACKET ASSEMBLY (0247-01-008)

Ref. Desig.	Description	Qty.	Mfr.	Manufacturer's Number
	BRACKET, Panel Mounting Right	1	Wilcom	0247-01-108
	RECEPTACLE	1	Simmons	P2-13

PARTS LIST

CONNECTING LEAD ASSEMBLY (0247-01-009)

Ref. Desig.	Description		Qty.	Mfr.	Manufacturer's Number
	CLIP		2	Mueller	#60
	RUBBER BOOT (RED)		2	Mueller	#62
	ZIP CORD (BLACK)	36"	1		SPT-1
	HEAT SHRINK TUBING	1"	2	Alpha	FIT 200-2

9.0 DIFFERENCE DATA

9.1 General

9.1.01 This section of the manual indicates information relative to changes in circuitry, operation, and features of the Model T247 Calibration Checker.

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